PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference MED2 1324PCT	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/US2004/012744	International filing date *(day/month/year)* 23.04.2004	Priority date *(day/month/year)* 24.04.2003
International Patent Classification (IPC) or national classification and IPC A62D3/00		
Applicant STERIS INC.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of sheets, as follows: (11)
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (Indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21.02.2005	19.12.2005

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/US2004/012744

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1, 2, 4-14	as originally filed
3, 3a	as amended (together with any statement) under Art. 19 PCT

Claims, Numbers

1-52	as amended (together with any statement) under Art. 19 PCT

Drawings, Sheets

1/7-7/7	as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☒ The amendments have resulted in the cancellation of:
   - ☒ the description, pages 3
   - ☒ the claims, Nos. 5,8
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-27
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-27
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-27
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US-A-5 998 691 (ABEL ET AL) 7 December 1999 (1999-12-07)

2. Independent claim 1.

2.1 Novelty:

Document D1 discloses that chemical warfare agents (CWA) are destroyed by a nitrogenous base which can be NH3 or amines followed by an oxidation by H2O2 or other oxidants (see col. 10, l. 34-60, col.13, l. 1-26, claims 30-33).
D1 also discloses that the destruction of CWA by this method does not necessarily require active metal in combination with the nitrogenous base (see col. 5, l.45-67 and col. 19, l. 29-34).
D1 discloses that NH3 or the amines should be in the liquid sate and it remains silent as far as the state of the H2O2 is concerned.
D1 also discloses that H2O2 is added after evaporation of NH3 (see col.13 l. 11-26 and col. 16, l. 45-50).
The subject matter of claim 1 differs from D1 in that the nitrogenous base and the peroxide are in a mixture, in gaseous and vapour state respectively.

The subject-matter of claim 1 is therefore new (Art. 33(2) PCT).

2.2 Inventive step:

The subject-matter of claim 1 differs from this known D1 in that the nitrogenous base and

the peroxide are in a mixture, in a form of gas and vapour respectively.

a) The effect of this distinguishing feature is that the decomposition agents can reach in a simple, fast and more efficient way contaminated areas such as crevices, fine cracks etc. and it can be used in spaces like interior of air planes, tanks or in electronic equipment where liquid compositions would create serious damages.

b) The problem to be solved by this distinguishing feature can be formulated as to simplify the process.

c) There was however no hint in the prior art available from the search report to solve this problem.

d) Hence an inventive step may be acknowledged.

On the other hand, G-agents, such as GD tend to be quite stable in the presence of hydrogen peroxide. GD does not undergo an autocatalytic perhydrolysis neutralizing reaction with hydrogen peroxide. Rather, G-type agents are typically deactivated with liquid hydrogen peroxide by base catalysis. Specifically, ammonia has been used to facilitate the base catalyzed hydrolysis of agents with liquid hydrogen peroxide, or perhydrolysis. Molybdate ions have also been used in combination with liquid hydrogen peroxide. The permolybdate ions formed have been found to deactivate G, V and H-agents.

The present application delivers a vapor phase deactivator which is effective against G, V, and H-type agents, as well as against biological agents.

Summary of the Invention

In accordance with one aspect of the present invention, a method of deactivating a pathogenic chemical agent is provided. The method includes subjecting the pathogenic chemical agent to a peroxide in the form of a vapor and a nitrogen containing compound in the form of a gas, a ratio of the peroxide to the nitrogen containing compound being between 1:1 and 1:0.0001. The nitrogen containing compound is of the general formula:

$$R_1\text{-}N(\text{-}R_3)\text{-}R_2$$

where R_1, R_2, and R_3 independently are selected from H and an alkyl group.

In accordance with another aspect of the present invention, an apparatus for deactivating a pathogenic chemical agent is provided. The apparatus includes a means for subjecting the pathogenic chemical agent to a mixture of a strong oxidant compound and an alkaline compound, both in a gaseous form.

In accordance with another aspect of the present invention, a method for decontamination of an item contaminated with GD. The method includes contacting the item in an enclosure with a vapor containing a peroxide and ammonia for sufficient time to reduce the concentration of GD to less than about 1% of

Having thus described the preferred embodiment, the invention is now claimed to be:

1. A method of deactivating a pathogenic chemical agent characterized by:

subjecting the pathogenic chemical agent to a peroxide in the form of a vapor and a nitrogen containing compound in the form of a gas, a ratio of the peroxide to the nitrogen containing compound being between 1:1 and 1:0.0001, the nitrogen containing compound being of the general formula:

$$R_1\text{-}N(\text{-}R_3)\text{-}R_2$$

where R_1, R_2, and R_3 independently are selected from H and an alkyl group.

2. The method as set forth in claim 1, further characterized by:

the peroxide including hydrogen peroxide.

3. The method as set forth in claim 1 or 2, further characterized by:

the peroxide being in the form of a vapor.

4. The method as set forth in claim 3, further characterized by:

vaporizing a liquid peroxide compound to form a peroxide vapor.

5. The method as set forth in claim 1, further characterized by:

the nitrogen containing compound including ammonia.

6. The method as set forth in claim 1, further characterized by:

the nitrogen containing compound including an alkyl amine.

7. The method as set forth in any one of claims 1-6, further characterized by:

the ammonia gas and the hydrogen peroxide vapor being present in a ratio of between 1:1 and 0.0001:1.0.

8. The method as set forth in any one of claims 1-7, further characterized by:

the nitrogen containing compound and peroxide being in the form of a gaseous mixture.

9. The method as set forth in claim 8, further characterized by:

the nitrogen containing compound being at a concentration of at least 1 ppm in the gaseous mixture.

10. The method as set forth in claim 9, further characterized by:

the nitrogen containing compound concentration being less than about 100 ppm.

11. The method as set forth in claim 10, further characterized by:

the nitrogen containing compound concentration being at least about 3 ppm in the gaseous mixture and less than about 20 ppm.

12. The method as set forth in claim 11, further characterized by:

the nitrogen containing compound including ammonia at a concentration of about 8 ppm.

13. The method as set forth in any one of claims 8-12, further characterized by:

the peroxide being at a concentration of at least 50 ppm in the gaseous mixture.

14. The method as set forth in any one of claims 8-13, further characterized by:

the peroxide being at a concentration of less than 1000 ppm in the gaseous mixture.

15. The method as set forth in claim 14, further characterized by:

the peroxide being at a concentration of at least 400-800 ppm in the gaseous mixture.

16. The method as set forth in claim 15, further characterized by:

the nitrogen containing compound including ammonia at a concentration of from about 3-20 ppm.

17. The method as set forth in claim 16, further characterized by:

the temperature being about 23-25°C.

18. The method as set forth in claim 16 or 17, further characterized by:

the peroxide including hydrogen peroxide at a concentration of about 600 ppm in the gaseous mixture.

19. The method as set forth in claim 18, further characterized by:

the nitrogen containing compound including ammonia at a concentration of about 8 ppm in the gaseous mixture.

20. The method as set forth in any one of claims 13-19, further characterized by:

the peroxide concentration being at least about 200 ppm in the gaseous mixture.

21. The method as set forth in any one of claims 8-20, further characterized by:

the gaseous mixture further including a carrier gas.

22. The method as set forth in claim 21, further characterized by:

the carrier gas including air.

23. The method as set forth in any one of claims 1-22, further characterized by:

the chemical agent including at least one of G-type, V-type, and H-type chemical agents, and combinations thereof.

24. The method as set forth in claim 23, further characterized by:

the chemical agent including a G-type chemical agent and the method including contacting the pathogenic chemical agent with the nitrogen containing compound and peroxide for sufficient time to reduce the G-type agent to a level of less than 1% of its original concentration.

25. The method as set forth in claim 23 or 24, further characterized by:

the contacting time being up to about six hours.

26. The method as set forth in any one of claims 1-25, further characterized by:

maintaining the temperature during the step of subjecting at from about 15°C to about 30°C.

27. The method as set forth in any one of claims 1-26, further characterized by:

the nitrogen containing compound being a liquid and the method further including vaporizing the liquid in a vaporizer.

28. An apparatus for deactivating a pathogenic chemical agent characterized by:

means (20, 32) for subjecting the pathogenic chemical agent to a mixture of a strong oxidant compound and an alkaline compound, both in a gaseous form.

29. The apparatus as set forth in claim 28, further characterized by:

the subjecting means including:

a vaporizer for vaporizing a peroxide liquid,

a supply (32) of a nitrogen-containing compound, and

a mixing region (30) for mixing the nitrogen containing compound and vapor.

30. The apparatus as set forth in claim 29 further characterized by:

means (24) for injecting hydrogen peroxide to the vaporizer at a rate of 0.4-0.5 grams/minute.

31. The apparatus as set forth in claim 29 or 30, further characterized by:

the mixing region being at the entrance of an enclosure (10) in which the pathogenic chemical agent is disposed.

32. The apparatus as set forth in claim 31, further characterized by:

a liquid hydrogen peroxide source for supplying liquid hydrogen peroxide to the vaporizer, and

the supply (32) of nitrogen containing compound including a compressed ammonia gas tank.

33. The apparatus as set forth in claim 32, further characterized by:

a control means (24, 34) which controls a rate of supplying the hydrogen peroxide to the vaporizer and a rate of supplying the ammonia gas to achieve a peroxide vapor to ammonia vapor ratio between 1:1 and 1:0.0001.

34. The apparatus as set forth in claim 32 or 33, further characterized by:

a control means (24, 34) which controls a rate of supplying the hydrogen peroxide to the vaporizer and a rate of supplying the ammonia gas to form a mixture in which a concentration of ammonia is at least 1ppm.

35. The apparatus as set forth in any one of claims 28-34, further characterized by:

the nitrogen containing compound including a liquid, and further characterized by:

a mister (30) for forming a mist of the liquid nitrogen containing compound.

36. The apparatus as set forth in any one of claims 28-35, further characterized by:

a chamber (10) connected with the mixing region for receiving items contaminated with the pathogenic chemical agent.

37. The apparatus as set forth in any one of claims 28-36, further characterized by:

the subjecting means including:

a means (50) for atomizing or vaporizing an alkaline liquid to form the nitrogen containing compound.

38. The apparatus as set forth in claim 37, further characterized by:

a peroxide vaporizing means (20) which generates a vapor or mist containing the peroxide; and

a chamber (10) connected with the atomizing or vaporizing means for receiving the vapor or mist.

39. A method for decontamination of an item contaminated with GD, the method characterized by:

contacting the item in an enclosure (10) with a vapor containing a peroxide and ammonia for sufficient time to reduce the concentration of GD to less than about 1% of its initial concentration, the time for the concentration to reach 1% of its initial concentration being less than 6 hrs.

40. A method of deactivating a pathogenic chemical agent characterized by:

forming a peroxide vapor;

increasing the pH of the vapor with a pH-increasing compound;

subjecting the pathogenic chemical agent to the peroxide at the increased pH for sufficient time to deactivate the chemical agent.

41. The method as set forth in claim 40, further characterized by the peroxide including hydrogen peroxide and the pH-increasing compound includes ammonia.

42. The method as set forth in claim 41, further characterized by the hydrogen peroxide being at a concentration of from about 200-800 ppm and the ammonia is at a concentration of from 3-40 ppm.

43. The method as set forth in claim 42, further characterized by the temperature being at room temperature.

44. A method of deactivating a biologically active substance characterized by:

subjecting the biologically active substance to a mixture of a strong oxidant compound and an alkaline compound; both in a gaseous form.

45. The method as set forth in claim 44, further characterized by:

the alkaline compound in gaseous form including a mist formed by atomizing a liquid alkaline compound.

46. The method as set forth in claim 44 or 45, further characterized by:

the strong oxidant including a peroxy compound.

47. The method as set forth in claim 46, further characterized by:

vaporizing a liquid peroxy compound to form a peroxy vapor.

48. The method as set forth in any one of claims 44-47, further characterized by:

the alkaline compound including at least one of ammonia and a short chain alkyl amine.

49. The method as set forth in any one of claims 44-48, further characterized by:

the peroxy compound including hydrogen peroxide.

50. The method as set forth in any one of claims 44-49, further characterized by:

the biologically active substance including one or more of chemical agents, pathogens, prions, and biotoxins.

51. The method as set forth in claim 50, further characterized by:

the biologically active substance including G-type nerve agents.

52. The method as set forth in claim 50, further characterized by:

the ammonia gas and the hydrogen peroxide vapor being present in a ratio of between 1:1 and 0.0001:1.0.